Let's Talk Water – BARCASS Hydrogeology

By Dr. Mike Strobel

In previous columns, I outlined the framework for the USGS-DRI ground-water study in eastern Nevada. This study, known as BARCASS (Basin and Range Carbonate Aquifer System Study), is the on-going evaluation of ground-water resources in and around White Pine County. This week, I would like to discuss the hydrogeology aspect of the study.

The study of hydrogeology consists of an evaluation of the geologic materials and structural features within a specified area and how these affect the occurrence and movement of water. Geologic materials can consist of sedimentary rocks, such as limestone or sandstone, igneous rocks, such as volcanic deposits and granite, metamorphic rocks, such as schist and marble, and a wide variety of unconsolidated sediments, such as alluvium, wind-deposited sands, and playa silts and clays. Structural features can include such things as folds, faults, fractures, domes, and basins.

The type of geologic material and occurrence of structural features can have a major effect on ground-water occurrence and movement. In simple terms, the primary porosity of the rocks or sediments can strongly relate to how much water an aquifer can hold. For example, sandstone typically can hold much more water than granite.

Secondary porosity, such as fractures and caverns, can really affect water storage. Limestone with extensive solution openings, ranging from caverns several feet wide to solution channels of carbonate rock along fractures and bedding planes less than an inch wide, will store more water than massive limestone without such features. These solution features form where carbonate rock is dissolved by carbonic acid derived from rain water containing carbon dioxide that infiltrates into the bedrock.

Structural features, such as domes and basins, can influence the direction of ground-water flow. Likewise, displacement along faults can either block ground-water movement along a geologic bed or can act as a conduit for ground-water flow.

In order to better understand how hydrogeology controls ground-water storage and movement in the BARCASS area, the study will complete the following tasks: (1) delineate regional geologic influences on ground-water flow, (2) perform geophysical studies, and (3) compile and evaluate data from oil and gas wells.

Regional geologic influences on ground-water flow will be delineated in three-dimensional diagrams of the geologic setting. These diagrams will include information on the thickness of the alluvium and depth to bedrock, composition of the rock and sediments, stratigraphy within the alluvium and bedrock, and structural features that influence ground-water flow. This will be based on geologic mapping, data from well drilling, geologic cross-sections (side views of the geology), and geologic information gathered from geophysical surveys and geochemical analysis.

Geophysical studies of the aquifer systems will characterize the geologic framework that influences ground-water movement. Data will be collected using regional gravity surveys, magnetic surveys, and electrical methods (these were discussed in an earlier column a few months ago). Geophysical investigations will help define where faults occur. These faults can limit or influence ground-water flow within and between basins. In addition, geophysical methods will help define the thickness of the different alluvium units, the depth to bedrock, the thickness of the carbonate bedrock, and the three-dimensional shape of the subsurface of studied basins.

The data from oil and gas wells will provide information for assessing the aquifer properties, such as transmissivity and porosity, at different depths and provide information of geologic thicknesses. In addition, data from oil and gas wells can be used to make estimates of storage properties in the aquifers. There are many geophysical borehole logs filed with the State that will be analyzed for geologic mapping and used to estimate hydraulic properties in the geologic materials surrounding the oil and gas wells. Because there are numerous oil and gas wells in eastern Nevada, the information obtained from these wells will provide a good distribution of hydrogeologic data across the study area and allow for more accurate three-dimensional representation of the subsurface setting.

Many of the field and analytical activities related to the hydrogeology of the study area will be carried out by geologists and geophysicists from the USGS offices in Denver, CO and Menlo Park, CA. Many of these individuals have spent much of their careers working in the Basin and Range and are very familiar with the geologic setting of the study area. In addition, many of these individuals are widely recognized for their expertise in geologic mapping and geophysical surveys. The data for the oil and gas wells will be analyzed in the USGS Carson City office by individuals who have extensive experience in eastern Nevada and were involved in earlier studies of this aquifer system.

The field activities related to assessing the hydrogeology of the study area will begin in the next few months and will continue through most of the project. The information concerning the hydrogeology is critical for the other components of the BARCASS and for understanding how water is stored and transmitted through these aquifers.

If you have any questions about the hydrogeology, please contact me through the Ely Times or at mstrobel@usgs.gov. Next week, we will discuss the recharge inflow and discharge outflow (the water budget) that will be addressed in the study.